

Remarks/Arguments

Applicants wish to thank the Examiner for the careful review of the claims, specification, and drawings.

Claims

Claims 1, 6 and 15 are currently amended.

Claims 5, 9-14, and 22 are cancelled

Claims 34-37 and 55-58 have been previously withdrawn.

Claims 2, 4, 18, 23-25, 27, 29, 39, 41-44, 50, and 54 have been previously presented.

Claims 3 and 45 have been previously canceled.

After entry of this amendment, claims 1-2, 4, 6-8, 15-21, 23-33, 38-44, and 46-54 are pending.

It is respectfully submitted that each and every feature recited in the pending claims are fully supported in the specification as filed.

No new subject matter has been added.

Rejections under 35 USC § 112

The Office Action argues that claim 1 is rejected under 35 USC § 112, first paragraph, as failing to comply with the written description requirement.

The Office Action argues that claims 2, 4-33, 38-44, and 46-54 are rejected under 35 USC § 112, first paragraph, as being dependent on rejected claim.

Claims 1, 2, 4-33, 38-44, and 46-54

Independent claim 1 is currently amended as detailed below in response to the rejection under 35 USC § 103. The amended claim 1 contains subject matter(s) which has been described in the specification as to reasonably convey to one skilled in the art that the applicants had possession of the claimed invention.

Therefore, applicants respectfully submit that the rejection to claim 1 under 35 USC § 112, first paragraph, be withdrawn.

Since rejection to claim 1 is now withdrawn, applicants respectfully submit that the rejection to claims 2, 4-33, 38-44, and 46-54 under 35 USC § 112, first paragraph, be withdrawn.

No new subject matter has been added.

The Office Action argues that claim 1 is rejected under 35 USC § 112, first paragraph, as failing to comply with the enablement requirement.

The Office Action argues that claims 2, 4-33, 38-44, and 46-54 are rejected under 35 USC § 112, first paragraph, as being dependent on rejected claim.

Claims 1, 2, 4-33, 38-44, and 46-54

Independent claim 1 is currently amended as detailed below in response to the rejection under 35 USC § 103. The amended claim 1 contains subject matter(s) which has been described in the specification as to enable one skilled in the art to make/or use the invention without undue experimentation.

Therefore, applicants respectfully submit that the rejection to claim 1 under 35 USC § 112, first paragraph, be withdrawn.

Since rejection to claim 1 is now withdrawn, applicants respectfully submit that the rejection to claims 2, 4-33, 38-44, and 46-54 under 35 USC § 112, first paragraph, be withdrawn.

No new subject matter has been added.

Rejections under 35 USC § 103

The Office Action argues that claims 1, 2, 4-7, 9-33, 38-39, 44, and 46-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shih et al. (U.S. 20030190870), hereinafter "*Shih*", in view of Han et al. (20030127049), hereinafter "*Han*", and in further view of Crevasse et al. (20020129393), hereinafter "*Crevasse*".

The Office Action argues that claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Shih*, *Han*, and *Crevasse* as applied to claim 2 above, and further in view of Suzuki et al. (US Patent 4,688,918), hereinafter "*Suzuki*".

The Office Action argues that claims 40-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Shih, Han*, and *Crevasse* as applied to claim 2 above, and further in view of *Amai et al.* (U.S. 7,063,094), hereinafter "*Amai*".

Claims 1, 2, 4-7, 9-33, 38-39, 44, and 46-54:

A rejection under 35 U.S.C. 103(a) requires that the combined references suggest the claimed combination (MPEP 706 and 2141 et seq.). Under the Graham test, three factors must be evaluated: the scope and content of the prior art; the differences between the prior art and the claimed invention; and the level or ordinary skill in the art (MPEP 706 and 2141 et seq.).

The Office Action argues that claims 1, 2, 4-7, 9-33, 38-39, 44, and 46-54 are rejected under 35 USC §103(a) as being unpatentable over *Shih* in view of *Han*, and in further view of *Crevasse* for various reasons.

Applicants have amended independent claim 1 to clarify the feature as followed:

1. (Currently amended) In a plasma processing system, a method of removing a set of particles including aluminum chloride from a set of structures including yttrium oxide, comprising the following steps in the sequence set forth:

exposing said set of structures to a first solution including an oxidizer for a first period;

removing said set of structures from said first solution;

exposing said set of structures to a second solution including a ketone reagent for a second period;

removing said set of structures from said second solution; and

rinsing said set of structures with de-ionized water and subsequently drying said set of structures with a filtered gas;

mechanically rubbing a surface of said set of structures with a third solution including a first set of acids for a third period, said third period being about 1 minute; and minute, wherein said third solution is configured to be

~~non-reactive with respect to said surface of said set of structures including said
yttrium oxide during said mechanical rubbing~~

rinsing said set of structures with said de-ionized water and
subsequently drying said set of structures with said filtered gas.

The support for the feature "...a set of particles including aluminum chloride..." may be found in the specification at least in paragraphs [0024 - 0031] and FIG. 3A. The support for the features "...rinsing said set of structures with de-ionized water and subsequently drying said set of structures with a filtered gas..." before and after the step of "...mechanically rubbing a surface of said set of structures with a third solution..." may be found in the specification at least in paragraphs [0037 - 0042] and steps 410 and 416 of FIG. 4.

In cleaning a set of particles including aluminum chloride from a set of structures including yttrium oxide using a strong inorganic acid solution, **the order of steps in the manner claimed in independent claim 1 is critical** (bold for emphasis).

The criticality of the sequence of steps, as discuss below, is to prevent the yttria coating from being damaged by the inorganic acid solution and the damage to the yttria coating further aggravated, causing undercut corrosion and delamination, when the aluminum chloride particles on the yttria coating react with moisture.

As discussed in the specification, inorganic byproducts (AlCl_3) are formed during plasma processing when chlorine (Cl) reacts with aluminum (Al) [0024]. The inorganic byproducts may pass through the porous yttria coating to the underlying stratum and cause corrosion [0025]. Upon exposure to moisture (H_2O), the inorganic byproducts (Al Cl_3) react to form hydrochloric acid (HCl) particles. The hydrochloric acid particles may react with the aluminum to form hydrogen gas (H_2) and more aluminum chloride (AlCl_3) particles. The created aluminum chloride (AlCl_3) particles again react with moisture to form additional hydrochloric acid, starting the process again. Thus, the presence of chlorine (Cl), moisture (H_2O), and/or hydrochloric acid (HCl) must be minimized or removed to prevent undercut corrosion and delamination [0026 - 0034].

In the cleaning methods of independent claim 1, moisture (H_2O) is removed from yttrium coating by **a filtered gas before and after mechanically rubbing the surface of the set of structures with an acid solution for a short period of time** (bold for emphasis).

The damage to the yttrium coating by the inorganic acid solution is reduced by minimizing the exposure of the yttrium coating to the inorganic acid solution without sacrificing the cleaning requirement. In order to minimize exposure, the surface of the set of structure is mechanically rub with the acid solution for about one (1) minute. The acid solution includes at least HF and HNO_3 instead of HCl to prevent reaction with the aluminum to form hydrogen gas (H_2) and more aluminum chloride ($AlCl_3$) particles.

The aggravated damage to the yttrium coating from undercut corrosion and delamination is prevented by removing moisture from the yttrium coating before and after the mechanical rubbing with the acid solution. By removing the moisture, the hydrochloric acid (HCl) particles are not formed, breaking the cycle to cause undercut corrosion and delamination.

However, applicant can not find in the teachings of the cited arts (*Han, Shih* and/or *Crevasse*) relied on by the Office action, taken alone or in combination, the criticality of employing the sequence of steps for cleaning a set of particles including aluminum chloride from a set of structures including yttrium oxide using an acid solution, in the manner claimed in independent claim 1.

In contrast, *Shih* teaches away from removing moisture, by employing a DI water rinse, before (step 160 of Fig. 1) and after (step 180 of Fig. 1) the acid cleaning step (step 170 of Fig. 1) [page 2, paragraphs 15-16; steps 160 – 180 of Fig. 1].

As discussed above, hydrochloric acid (HCl) particles will form upon of exposure inorganic byproducts ($AlCl_3$) to moisture (H_2O). The hydrochloric acid particles may react with the aluminum to form hydrogen gas (H_2) and more aluminum chloride ($AlCl_3$) particles. The created aluminum chloride ($AlCl_3$) particles again react with moisture to form additional hydrochloric acid, starting the process again.

Furthermore, *Shih* teaches the use a plasma condition step employing Cl (step 220 of Fig. 1) to provide chemically reactive mechanism for cleaning [pages 2-3, paragraphs 18-19; step 220 of Fig. 1]. As discussed above, inorganic byproducts

(AlCl_3) are formed during plasma processing when chlorine (Cl) reacts with aluminum (Al). Thus, *Shih* teaches away from cleaning the set of particles including aluminum chloride from a set of structures including yttrium oxide by generating more aluminum chloride particles with plasma conditioning employing Cl.

Yet further, *Shih* teaches equivalent substitution of the acid ($\text{HF}:\text{NO}_3:\text{H}_2\text{O}$) cleaning solution with an $\text{HCl}:\text{H}_2\text{O}_2$ solution [page 4, paragraph 25; Fig. 1]. As previously discussed, HCl may react with the aluminum to form hydrogen gas (H_2) and more aluminum chloride (AlCl_3) particles. Thus, *Shih* teaches away from cleaning the set of particles including aluminum chloride from a set of structures including yttrium oxide by generating more aluminum chloride particles with the HCl.

The Office Action argues that the length of time the structures are left in contact with the solution may be determined routinely one of ordinary skill in the art without undue experimentation. *Shih* teaches dipping the structures in the cleaning solution for about one (1) hour, i.e. 60 minutes. In contrast, the time period for mechanically rubbing the cleaning solution on the surface of the structures is about one (1) minute. The difference between the time periods is almost two orders of magnitude.

Applicants respectfully traverse. It is not obvious to one of ordinary skill in the art to get to two orders of magnitude difference in time without undue experimentation, especially when two different processes, i.e. dipping versus mechanical rubbing, are involved.

Therefore, it would not be obvious to take the yttrium oxide coated ceramic parts taught by *Han* as the parts to be cleaned using the cleaning methods as taught by *Shih* and substituting the dipping with the rubbing of *Crevasse* with a reasonable expectation of success. On the contrary, the combination of the teachings of *Shih*, *Han*, and/or *Crevasse*, taken alone or in combination, as suggested by the Office Action is not logical and may destroy the intended cleaning of the set of particles including aluminum chloride from a set of structures including yttrium oxide damaging the coating by inducing more corrosion and AlCl_3 particles.

Hence, due to the complexities of the surface chemistries of yttrium coated surfaces in plasma processes, the method(s) for cleaning of yttrium coated parts is not obvious and can not simply be combined by the suggested references of *Shih, Han*, and/or *Crevasse*, taken alone or in combination, to achieve reasonable success. As aforementioned, the combination of *Shih, Han* and/or *Crevasse* is not logical and would produce an inoperative cleaning method that can cause corrosion to yttrium coated parts.

For the above reasons and others, it is respectfully submitted that the independent claim 1 is novel, nonobvious, and patentable over the cited art(s), taken alone or in combination. Consequently, Applicants submit that the rejection of independent claim 1 under 35 USC § 103(a) be withdrawn.

Dependent claims 5 and 9-14 are cancelled since the features have been incorporated into amended independent claim 1.

Dependent claim 6 has been amended for proper dependency on the parent claim.

Dependent claim 15 has been amended to correct editorial problem.

Dependent claims 2, 4, 6-8, 15-21, 23-33, 38-39, 44, and 46-54 depend from independent claim 1 and require additional elements or features not taught or suggested by the cited arts, taken alone or in combination. Since independent claim 1 should now be allowable, Applicants submit that the rejection of dependent claims 2, 4, 6-8, 15-21, 23-33, 38-39, 44, and 46-54 under 35 USC § 103(a) be withdrawn.

No new subject matter has been added.

Claim 8:

The Office Action argues that claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Shih, Han*, and *Crevasse* as applied to claim 2 above, and further in view of *Suzuki* for various reason(s).

Dependent claim 8 depends from dependent claim 2, which depends from independent claim 1, and requires additional elements or features not taught or suggested by the cited arts, taken alone or in combination. Since independent claim 1

should now be allowable, Applicants submit that the rejection of dependent claim 8 under 35 USC § 103(a) be withdrawn.

No new subject matter has been added.

Claims 40-43:

The Office Action argues that claims 40-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Shih, Han, and Crevasse* as applied to claim 2 above, and further in view of *Amai* for various reason(s).

Dependent claims 40-43 depend from dependent claim 2, which depends from independent claim 1, and require additional elements or features not taught or suggested by the cited arts, taken alone or in combination. Since independent claims 1 should now be allowable, Applicants submit that the rejection of dependent claims 40-43 under 35 USC § 103(a) be withdrawn. No new subject matter has been added.

Double Patenting

The Office Action indicates that claim 22 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof should claim 21 found to be allowable.

Applicants have canceled claim 22.

CONCLUSION

In view of the discussion herein, Applicants believe that all pending claims are allowable and respectfully request a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application the undersigned can be reached at the telephone number set out below.

If any petition is required to facilitate the entry of the present amendment, please consider this communication a petition therefore as well. The Commissioner is authorized to charge any fees beyond the amount enclosed which may be required, or to credit any overpayment, to Deposit Account No. 50-2284 (Order No. LMRX-P023/P1130).

Respectfully submitted,

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